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THE COLLEMBOLA [INSECTA] OF THE UNCULTIVATED FIELDS IN BURDWAN DISTRICT (WEST BENGAL), WITH REMARKS ON CORRELATION BETWEEN MONTHLY POPULATION AND CERTAIN SOIL FACTORS

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ABSTRACT

This communication is a part of the ecological investigation of collembolan populations in West Bengal. Altogether 24 samples were collected from two undisturbed, uncultivated and well-vegetated plots at a village in Burdwan district, at monthly intervals over a period of 12 months. The collembolan fauna obtained belonged to four genera of which *Proisotoma* and *Cyphoderus* were numerically dominant. The total population showed monthly variations in number, being maximum in November and minimum in February. Out of seven soil factors only three, *viz*, organic carbon, calcium carbonate and particle size, showed weak positive correlation with the population. Vertical distribution study revealed that most of the forms were predominant in upper subsample.

INTRODUCTION

Qualitative and quantitative ecology of the collembolan populations in different habitats have been studied by workers like Murphy (1953), Bellinger (1954), Sheals (1957), Haarlov (1960), Christiansen, *et al.* (1961), Poole (1961), Choudhuri (1962), Dhillon and Gibson (1962), Milne (1962), Davis (1963), Rapoport and Najt (1965), Choudhuri and Roy (1965, 1967) in different parts of the world. There are reasons to believe that the animal life of the soil plays some role in its economy, though hardly appreciated in our country, and the activity of the microfauna is of great importance in the determination of the characters and fertility of the soil. In view of the above, the present authors have undertaken extensive investigation on the ecology and bionomics of Collembola of West Bengal, of which the present communication dealing with the effects of soil conditions on the collembolan populations and their distribution in the district of Burdwan, is an outcome.

ECOLOGY OF THE SAMPLING PLOTS

Burdwan district is one of the westernmost districts of West Bengal. It extends up to the river Hooghly on its eastern side, with the Tropic of Cancer running across the middle. It is mostly plains with an area of about 7003 sq. km

and average annual rainfall ranging between 1143 and 1397 mm. The soils of this district are chiefly divided into three groups, *viz*, laterite, red soil, and alluvial soil.

Two uncultivated low-lying plots, 'A' and 'B', with more or less equal areas (90 × 40 m) in the village Pahalanpur located within 8 km from the river Mundeswari under Raina Police Station, were selected for sampling. Plot 'A' was thickly covered with grass and a few weeds, such as *Euphorbia hirta* (Euphorbiaceae), *Mikania scandens* (Compositae) and *Panicum crusgali* (Graminae), while plot 'B' was sparsely covered with grass and the only shrub *Euphorbia hirta* (Euphorbiaceae).

MATERIAL AND METHOD

Twelve soil samples from each plot were collected at monthly interval over a period of one year (from November 1964 to October 1965). They were collected by a steel borer as employed by Dhillon and Gibson (1962) and the cores were extracted by Tullgren funnel modified by Macfadyen (1953). Soil factors studied were pH, moisture content, organic carbon, calcium carbonate, phosphate, nitrate and particle size. Colorimetric method for nitrate and phosphate and oven-drying method for moisture determination as described by Dowdeswell (1959) were followed. Rapid titration method for calcium carbonate and Walkley and Black's method for organic carbon detection as described by Piper (1942) were adopted. The pH was determined from soil suspension by an electric pH meter and particle size was measured by using an ocular micrometer taking 1000 particles at random.

OBSERVATION

Soil conditions: Soils of both the plots were alluvial in nature, dark grey in colour and sandy loam in texture. At times the moisture levels of both the plots increased to a considerable extent. The values of pH ranged between 6.6 and 7·5 in plot 'A', and between 6·8 and 7·4 in plot 'B'. The organic carbon, nitrate and phosphate contents of both the plots were considerably high. Mean values of the soil factors of both the plots are shown in Table 1.

TABLE 1.—*Mean values of soil factors (12 samples from each plot).*

Plot	pH	Water content (%)	Organic carbon (%)	Calcium carbonate (%)	Nitrate	Phosphate (ppm)	Particle size (mm)
A	7·00	8·6	1·02	2·5	1·39	0·62	0·090
B	7·03	8·0	1·03	2·7	1·13	0·60	0·076

Collembolan population: The collembolan fauna obtained from both the plots belonged to four genera. In plot 'A' the species obtained were *Cyphoderus assimilis*, *Proisotoma minuta* and *Lobella* sp., and those extracted from plot 'B' were *C. assimilis*, *P. minuta* and *Lepidocyrtus cyaneus*. All these species were found in each of the samples (Table 2). Of the total of 24 samples collected, 19 contained 40-80 specimens and the remaining five contained 80 to 100 specimens or more. The highest and the lowest numbers collected in a sample were 112 and 40 respectively. The nature and number of Collembola encountered in different months are listed in Table 2 which will show that the plot 'A' was comparatively thickly populated than plot 'B'. The genera *Cyphoderus* and *Proisotoma* were found in both the plots while the genera *Lepidocyrtus* and *Lobella* were absent in plot 'A' and plot 'B' respectively. The order of species-dominance could be expressed as *Proisotoma*<*Cyphoderus*<*Lepidocyrtus*<*Lobella*.

TABLE 2.—*Monthly variation in collembolan populations.*

Plot	Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Percentage of total no of specimens of Collembola
A	*Cyphoderus assimilis*	24	8	36	28	32	24	28	58	42	8	28	24	40·86
	Proisotoma minuta	56	32	20	24	36	16	24	16	20	24	72	40	45·67
	Lobella sp.	12	4	8	4	8	8	16	8	4	8	12	20	13·46
B	*C. assimilis*	16	12	16	32	28	32	24	52	40	4	16	16	40·00
	P. minuta	28	24	12	24	8	8	20	28	16	36	44	60	42·77
	Lepidocyrtus cyaneus	16	4	8	12	8	16	8	4	12	8	12	16	17·22
	Total for each month	152	84	100	124	120	104	120	166	134	88	184	176	

Seasonal variation: The population of Collembola of both the plots taken together was found to reach the maxima in winter months, *i.e*, November to January. Analysis of populations on individualistic basis also revealed that the populations of *Lepidocyrtus*, *Proisotoma* and *Lobella* had winter maxima and they were mainly responsible for the pattern of variation shown by the total collembolan fauna. The populations of *Cyphoderus* in both the plots, however, reached the peak in August-September, *i.e*, in the late monsoon period.

Vertical distribution: For this study 12 samples from each plot, one in each month of the sampling year, were taken and the results obtained are stated in Table 3, which will reveal that all species except that of *Lobella* which was found in greater concentration in the lowermost layer, were mostly concentrated in the upper and middle layers of the soil.

TABLE 3.—*Plot-wise vertical distribution of Collembola.*

Plot	Species	Total number of collembolan specimens in upper layer (0—5 cm)	middle layer (5—10 cm)	lower layer (10—15 cm)
A	*Cyphoderus assimilis*	160	248	36
	Proisotoma minuta	152	104	44
	Lobella sp.	20	36	72
B	*C. assimilis*	116	128	24
	P. minuta	164	108	40
	Lepidocyrtus cyaneus	88	48	12

DISCUSSION

Both the plots in this investigation were more or less identical in their ecological characteristics. Mechanical analysis of the soils of the sampling plots (Table 4) also showed little differences between them. In spite of this nature of environmental make-up there was significant gap as to the nature and abundance of collembolan populations between the plots.

TABLE 4.—*Mechanical analysis of soil samples.*

Plot	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
A	1·45	52·90	23·25	17·70
B	1·60	51·20	23·45	19·15

The mean value of the soil factors and collembolan populations as listed in Table 5 revealed that the values of the soil factors excepting the water-content which increased to a considerable extent in June-August, did not markedly fluctuate. The total population, leaving aside winter maxima, had another peak period in August solely contributed by the population of *Cyphoderus assimilis.*

It also showed two lean months, February and October, when the minimum number of Collembola was come across.

TABLE 5.—*Mean values of soil factors and mean numbers of Collembola in different months.*

Month	pH	Water content (%)	Calcium carbonate (%)	Organic carbon (%)	Nitrate (ppm)	Phosphate (ppm)	Particle size (mm)	Mean no. of Collembola
Jan	7·0	6·8	2·1	1·09	1·15	0·44	0·083	76
Feb	6·8	7·1	2·2	1·08	1·92	0·52	0·078	47
Mar	7·3	6·5	2·3	0·95	1·80	0·56	0·116	52
Apr	7·0	7·0	1·7	0·80	0·89	0·70	0·054	62
May	6·8	6·5	2·5	0·98	1·20	0·45	0·110	60
Jun	7·1	10·9	2·5	1·10	1·08	0·52	0·060	52
Jul	7·3	11·4	3·4	1·13	0·89	0·65	0·070	60
Aug	7·0	10·0	3·3	1·10	1·40	0·79	0·080	83
Sep	6·7	9·5	3·0	1·12	0·82	0·77	0·095	67
Oct	7·0	8·8	2·4	0·96	1·06	0·75	0·073	44
Nov	7·0	7·8	2·9	1·00	1·34	0·54	0·080	92
Dec	7·2	7·0	2·5	0·99	1·01	0·66	0·097	88

The correlation coefficient values ('r') when worked out (Table 6) showed that the collembolan population was positively correlated with organic carbon, calcium carbonate and average particle size but negatively with the other factors. But the values were not sufficiently high to be significant. The organic carbon, phosphate and calcium carbonate had positive correlation with moisture content while nitrate showed negative value with moisture as well as organic carbon. Average particle size had positive but weak correlation with organic carbon and calcium carbonate but negative with moisture content. In view of the above findings the winter maxima of the collembolan populations as found here could not be explained.

TABLE 6.—*Correlation co-efficient ('r') of soil factors and collembolan populations.*

Factors correlated			Value of 'r'
Collembolan population	&	Moisture content	−0·157
-do-	&	Organic carbon	+0·078
-do-	&	Calcium carbonate	+0·258
-do-	&	Nitrate	−0·198
-do-	&	Phosphate	−0·248
-do-	&	Particle size	+0·114
Moisture content	&	Organic carbon	+0·584
-do-	&	Nitrate	−0·412
-do-	&	Phosphate	+0·414
-do-	&	Calcium carbonate	+0·643
-do-	&	Particle size	−0·253
Organic carbon	&	Nitrate	−0·171
-do-	&	Phosphate	−0·075
-do-	&	Particle size	+0·131
-do-	&	Calcium carbonate	+0·573
Calcium carbonate	&	Particle size	+0·096

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